25X1

Project No. A-100

THICKNESS MEASUREMENT OF
NON-METALLIC MATERIALS

Progress Report No. 10

for

25X1

Dec. 11, 1957

Copy No. 1

25X1

Declassified in Part - Sanitized Copy Approved for Release 2012/04/10 : CIA-RDP78-03172A000300050040-1

Page Denied

THICKNESS MEASUREMENT OF NON-METALLIC MATERIALS

I. INTRODUCTION

This is a report of the progress on [redacted] Project No. A-100 for the period of October 1 through October 31, 1957. The purpose of this project is to develop an ultrasonic method of determining the thickness of non-metallic materials. Since, for various reasons, concrete represents the most difficult case, the experimental work has been done with concrete samples. 25X1

Assuming that the velocity of sound in the sample is known or can be found, there are two ways in which the thickness of a sample can be determined. The first of these is to measure the time required for an ultrasonic pulse to travel through the sample block, be reflected from the far side and return to the near side. The thickness is then one-half the quotient of the velocity divided by the travel time.

The second approach is to measure the frequency at which the sample resonates in a thickness mode. Since the wall must then be a half wavelength at this frequency the thickness is equal to the velocity divided by twice the frequency. Thus, for a frequency range of 20 kcps to 40 kcps, assuming a velocity of 15,000 feet per second for concrete, the wavelength varies from 9 inches to 4-1/2 inches and the measurable thickness range from 4-1/2 inches to 2-1/4 inches.

The measurable range can be extended to greater thicknesses when the harmonics are measured. For example, a sample one foot thick will have resonances when the wavelength is an integral submultiple of two feet, i.e., at wavelengths of two feet (7500 cps), one foot (15 kcps), 2/3 foot (22.5 kcps), 1/2 foot (30 kcps), etc. It should be noted that the difference between any two resonant frequencies is always 7.5 kcps. Thus either the measurement of the fundamental frequency or the difference between two adjacent harmonic frequencies allows the determination of the wavelength at the fundamental resonance, which wavelength is twice the thickness of the sample.

II. PROGRESS OF WORK

The difficulties in the use of the resonance technique for measuring the thickness on concrete arise from the weakness of the desired resonances in the concrete as compared to the resonances of other modes in the concrete and, at times, to the resonances in the transducer. Much of the work in the period covered by this report has been directed toward the improving of the various detection systems described in previous reports in an attempt to improve the detection of the desired resonances. Various sizes and shapes of transducers were tried along with various means of coupling the transducer to the sample. No significant improvement was obtained.

One new method of resonance detection, the pulse-resonance method, was investigated during the period of this report. In the pulse-resonance method a short pulse of ultrasonic energy at a given frequency is delivered to the sample through a suitable transducer. The build-up and decay of the energy in the sample is then monitored, either with the sending transducer or, more satisfactorily, with a second transducer placed near the first. When the frequency of the ultrasound in the pulse is equal to one of the resonant frequencies of the sample, the energy in the sample builds up to a higher value and decays more slowly. Thus the envelope of the signal picked up from the sample indicates if one is far from, near, or at the resonance. This method, like all resonance methods, was successful on some sample blocks, but failed on other sample blocks because of the presence of resonances due to modes other than the longitudinal.

The afternoon of October 23rd was spent at the ultrasonic laboratories at Michigan State University. October 24 through October 26 was spent at the Acoustical Society of America meeting at Ann Arbor, Michigan. Although in neither place could the problem be discussed openly, any information obtained only served to confirm results already found in this laboratory and noted in these reports.

III. FUTURE PLANS

We now believe that we have exhausted the possibilities of the resonance technique, at least with the knowledge that we now possess. Unless new information relating to this technique alters the picture, future work will be concerned with the pulse-echo technique. The major problem here will be to increase the damping of the transducer so that sufficiently short pulses of energy can be obtained.

IV. NOTEBOOKS

Data contained in this report are recorded in Notebook No. C-6516.

V. CONTRIBUTING PERSONNEL

Work on this projett was performed by [redacted] under the supervision of [redacted]

25X1 25X1

Respectfully submitted,

[redacted]

25X1

APPROVED:

[redacted]

25X1